Issues associated with quantifying the impacts of the macroeconomic benefits derived from energy efficiency and energy savings

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Issues paper

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Introduction and overview of the foundation and nature of *macroeconomic benefits* derived from energy efficiency

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Issue 1. Macroeconomic impacts have solid theoretical foundations

- "Valuing the full range of multiple benefits of energy efficiency at the macroeconomic level challenges the conventional relationship between energy performance and economic growth: where previously economic performance drove energy consumption upwards, reduced energy consumption now appears to have substantial positive impacts for economic development" (IEA, 2014, p.45)

- **Key Message 1. Macroeconomic impacts have theoretical foundations**: The relationship between energy efficiency and economic growth is not just an empirical phenomenon. It has solid analytical and theoretical foundations: Any reduction in energy used per unit of economic activity leads to cost reductions, freeing up income and productive capacity.

- This is important in terms of the wider credibility of the multiple benefits 'message' and basis for more consistent communication of study findings.

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Issue 2. There are two stages in improving energy efficiency

- "investment effects being the results derived from increased investment in energy efficiency goods and services…
- ….energy demand or cost reduction effects, which comprise the effects arising from the energy demand reduction (or reduced costs) associated with actually realising an improvement in energy efficiency." (IEA, 2014, pp. 46-47)
- **Key Message 2**. **There are two stages in improving energy efficiency:**
- 1) Investment or "enabling";
- 2) Energy demand reduction effects or "realising".
- Impacts from the enabling stage are more likely to be short-term; whereas impacts from the realising stage are more likely to be long-term. Moreover, financing requirements may dampen the sustained positive impacts on the economic growth trajectory from actually realising energy efficiency gains.

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Issue 3. Just how the economy expands depends on the type of activity that becomes more energy efficient

- "An important consideration is that the economic effects of energy efficiency measures are different for final consumers (i.e. households) and energy-using producers (i.e. businesses)…

- …For final consumers, increased energy efficiency can lead to a demand shift from energy consumption to other goods. The producing sectors (business consumers) are more likely to see a benefit in more competitive production" (IEA, 2014, p. 47).

- **Key Message 3. The impact of energy efficiency on economic growth depends on whether efficiency gains take place on the production or consumption side of the economy**.
  - On the production side, EE leads to cheaper production costs, which may be passed through to prices. **Any economic expansion will be productivity-driven.**
  - On the consumption side, EE allows for expanded consumption on a variety of goods and services, thanks to a reduced cost of energy. **Any economic expansion will be demand-driven**.
  - Demand-led expansion may be more likely to trigger crowding out effects that put upward pressure on prices, thereby negatively impacting competitiveness.

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Issue 4. The need to inform policy in a practical and useful way

- **Key Message 4. The output of macroeconomic models needs to be carefully communicated by modellers**, particularly by articulating the precise nature of costs and benefits measured by indicators. Modellers should be able to communicate whether impacts on economic growth are truly additional and sustained over time and what they say about human well-being.
  - **Time and adjustment** issues are important: policy makers may be sceptical of job creation claims, both in terms of sustainability over time and whether the activity involved should be regarded as 'new' work or simply a reallocation of labour between sectors in a given timeframe.
  - **Context affects indicator selection** which can make international comparability difficult: National policymakers want to impose particular constraints on models that reflect national priorities (e.g. balanced budgets or full employment) but these constraints change modelling results significantly.
  - **Economic indicators may not fully represent, or even misrepresent, impacts on individual and societal welfare.** Modellers must be clear on what indicators actually say or do not say about welfare (and why or why not).

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II. Issues in considering different approaches to quantifying impacts

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Model comparisons

Figure 1 Overview of several macroeconomic models of energy efficiency impacts

Model name	Model type	Scope	Impacts
World Energy Model[A]	Partial equilibrium	Global	Energy prices and expenditures, investment
GINFORS[B]	Econometric	Global	GDP, employment, trade, CPI, distribution
E3ME[C]	Econometric	EU member states	GDP, employment, CPI, distribution, trade
ENV-Linkages[D]	CGE	Global	GDP, employment, trade and value-added by sector.
ThreeME[E]	CGE	France	GDP, employment, trade, distribution, public budget
HMRC CGE model[F]	CGE and BCA	UK	GDP, employment, public budget
REMI[G]	CGE and I-O	Canadian provinces	GDP, employment, public budget
UKENVI[H]	CGE and I-O	UK	GDP, employment, trade, public budget, aggregate distribution effects, investment behavior and sectoral activity levels
IKARIS[I]	Bottom-up buildings systems model with I-O	Germany	Public budgets, employment
3CSEP model[J]	Bottom-up buildings sector with I-O	Hungary	GDP, employment
Copenhagen Economics model[K]	PCGE/macroeconomic multipliers	Regional (EU)	GDP, trade, CPI, employment
PANTA RHEI[L]	Econometric	Germany	Employment, trade, value-added, production
SEAI model[M]	BCA	Ireland	GDP, employment, public budget

Graph title, centered

Key Message 5. There is a fundamental trade-off between the strengths (and weaknesses) of the two main macroeconomic modelling approaches, Macro-econometric (ME) and Computable General Equilibrium (CGE) models. However, this may provide opportunities to draw on the insights of both.

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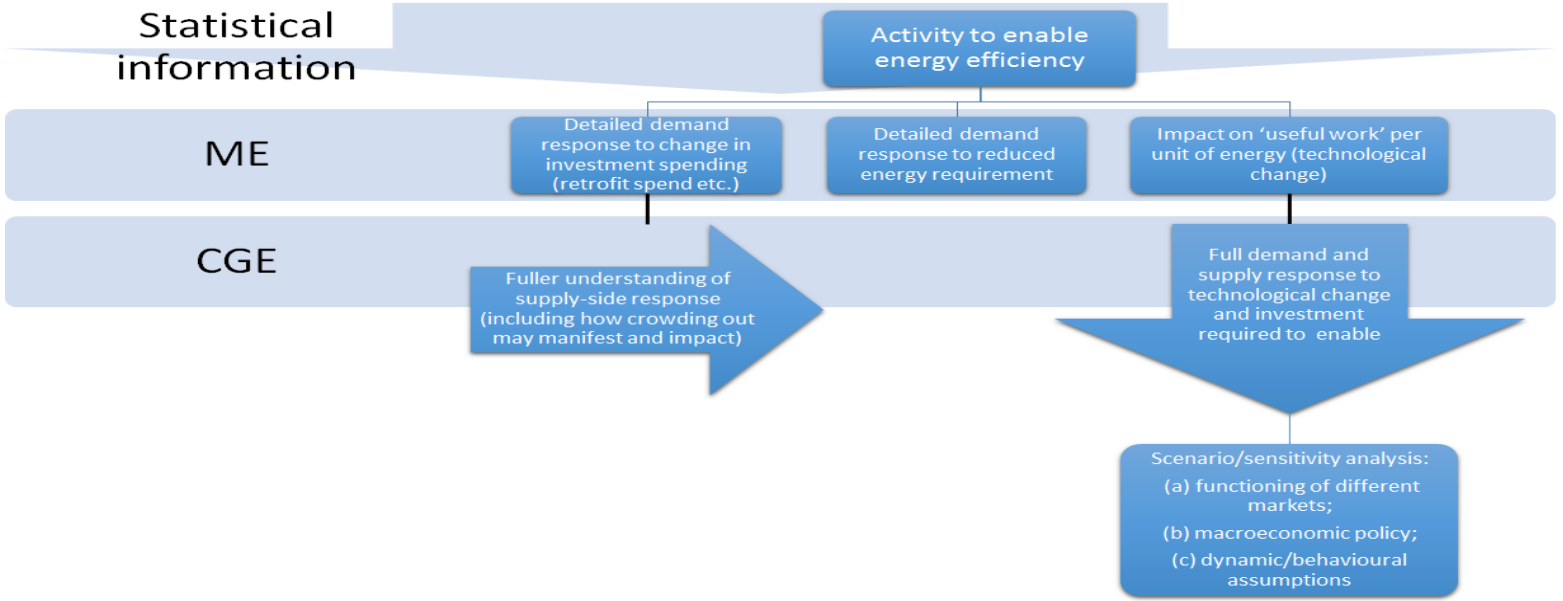
The need for a more integrated approach: opportunities and challenges

Figure 3 Potential basic process of interacting ME and CGE macroeconomic models



Key Message 6. It is possible – and often necessary – to use more than one tool to model the macroeconomic impacts of energy efficiency actions. The trick is to choose the right tool for each part of the job.

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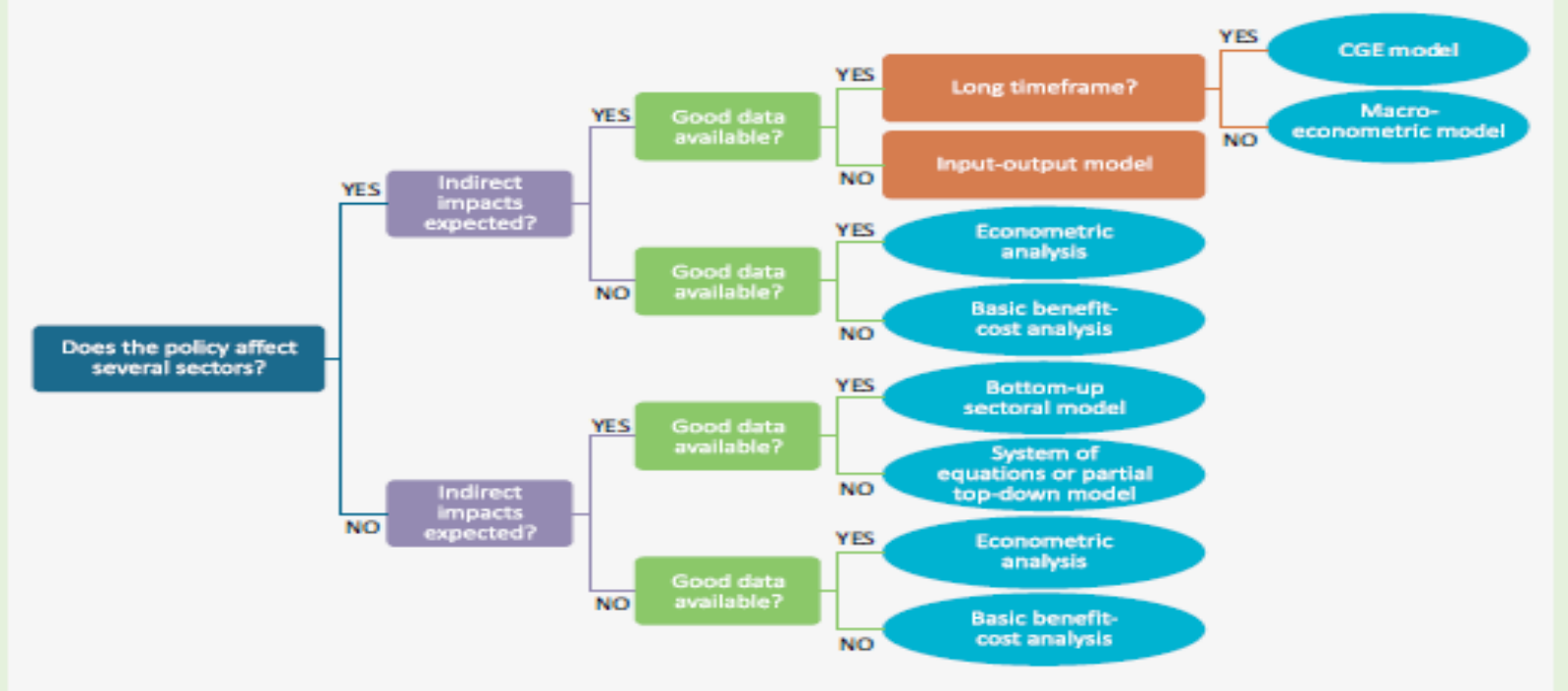
Practical implications

Figure 1 Decision tree for choosing the most appropriate assessment method



Key Message 7. Bringing modellers from different camps together to collaborate may help to move beyond the obstacle of deciding between 'competing' modelling approaches. However, in many contexts, the skills required to develop and usefully use complex macroeconomic models may limit the choice of model used as a matter of necessity.

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III. Key issues associated with macroeconomic analysis

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Interpreting results and communicating them to policy makers

- What if we can't overcome all the practical issues of skills, data and computing requirements?
- Particularly in challenging policy environments
- Another (possibly complementary) route may be to start with simpler modelling approaches and metrics – e.g. input-output multiplier analysis
- **Key Message 8.** There are important trade-offs to be considered in terms of how model results are generated. This will impact how they should be interpreted and communicated to help policymakers address the questions and challenges they face.

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Making the case that macroeconomic impacts of energy efficiency should not be ignored

- **Key Message 9. The macroeconomic case for energy efficiency actions does seem to be gaining a strong foothold globally**. It is essential that analyses are conducted responsibly, rigorously and intelligently, establishing firm theoretical/analytical and statistical/empirical foundations where possible, while also ensuring that results are communicable and transparent. Balancing these demands is likely to involve trade-offs and requires more meaningful and extensive collaborations within the research community and between researchers and policy makers.

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Dealing with the rebound effect and other issues related to energy conservation/ climate change goals

- At time of writing IEA 2014, high level of 'distraction' in research community with measuring 'rebound'?
- 'Overdose' with journals and policy interest may have helped initiate shift in focus
- **Key Message 10.** There is a continued need for modellers **to focus on how to better estimate and communicate rebound and economic effects** of energy efficiency policies.
- This must incorporate consideration of how the two are related to one another and how this impacts their development over time in different contexts.
- Fuller social (rather than just economic) welfare considerations require consideration of the value attached (by individuals and society as a whole) to different energy services and product attributes impacted by energy efficiency actions.

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IV. Key developments in applied studies since 2014

- Emerging economy studies – simpler approaches and focus on policy interests
- Spatial focus and potential for bottom-up informing of macroeconomic studies via both engineering and financial/economic/techno-economic models
- **Key Message 11.** Since the publication of the IEA 2014 book, **interest in 'capturing the multiple benefits of energy efficiency' has grown**.
- In emerging economies contexts, interest seems to be focussed on how specific types of important macroeconomic impacts (for example, employment and public budget impacts) may be measured and explained in a relatively direct way.
- More generally, there is interest in how causality feeds through from 'micro' to 'macro' levels.
- This introduces a challenge in that the former implies a need for simpler, more transparent models while the latter demands greater integration between different types of 'bottom up' and 'top down' models.

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Recommendations

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Building on those in the IEA 2014 Book….

1. **Benefit areas and causal linkages** – importance of theoretical linkages and gaps (welfare)

2. **Data, indicators and metrics** – importance of national priorities but also increasing focus on public budgets, ‘energy productivity’

3. **Assessment methodologies** – model linkages not only in terms of bottom-up engineering: micro-meso-macro and macro-macro

4. **Collaborative initiatives** – not limited to intra-governmental: government-research, modeller-modeller

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